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High-energy x-ray imaging instrumentation and applications for the National Ignition Facility*

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ABSTRACT

Multi-keV x-ray imaging is expected to be an important diagnostic for laser-produced plasma experiments at the National Ignition Facility (NIF). Examples of experiments in which high-energy, high-resolution imaging is critical include backlit shock radiography for diagnosis of time-dependent radiation symmetry, emission imaging of doped capsules for diagnosis of temperature and density non-uniformities, and shock trajectory measurements for equation-of-state studies. Common characteristics for these applications include multi-keV photon energies, narrow spectral emission bandwidths, < 5 μm spatial resolution in one- or two-dimensions, high magnification, and a severe radiation environment requiring large stand-off distances for survivable, multiple-use instruments. We have investigated several instrumentation options in detail, including close working-distance pinholes, Fresnel zone plates, two-element Kirkpatrick-Baez microscopes using metal, multi-layer and bent-crystal optics, and near-normal incidence spherical crystal imagers, and we will discuss these options in view of the intended applications.

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